

NAVAL WAR COLLEGE
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"HIDE YOUR SHAPE" - SUN TZU
ROE CONSIDERATIONS FOR NEGATING HIGH-RESOLUTION COMMERCIAL
IMAGERY SATELLITES

by

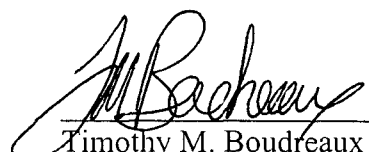
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A paper submitted to the faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Maritime Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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5 February 1999


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ABSTRACT

During 1999, the first commercial satellite capable of producing imagery with 1-meter resolution will be launched. This event is significant because 1-meter resolution is considered as the baseline for military grade imagery. To counter this threat, the commander may ultimately have to take action against the space assets of a corporation that resides in a belligerent or a neutral nation. The Rules of Engagement that would guide this attack are developed based on U.S. policy, international and domestic law, and operational considerations. An analysis of these factors indicates that there are few impediments to the execution of "Offensive Counter-Space" operations against the commercial imaging threat. A proposal is also made for the addition of three General Supplemental Measures regarding the engagement of commercial space systems to the Chairman of the Joint Chiefs of Staff Instruction 3121.01, Standing Rules of Engagement.

INTRODUCTION

In *The Art of War*, Sun Tzu emphasizes the importance of concealing the disposition or "shape" of friendly forces.¹ During Operation Desert Storm, General H. Norman Schwarzkopf successfully applied this principle by denying Iraq's leadership access to operational intelligence and thereby enabling a decisive attack on the enemy's western flank. As the new millenium approaches, the commander's task of concealing his force dispositions will become increasingly difficult.² This is largely due to the expected proliferation of high-resolution (1-meter) commercial imagery satellites. In June 1999, the U.S. Ikonos-1 satellite is scheduled for launch as the first platform that will provide 1-meter commercial imagery.³ This threat of observation has serious implications, especially for the employment of U.S. doctrine which stresses operational maneuver.⁴ To counter the commercial reconnaissance threat, commanders may have to rely on the use of force. As with any mission that involves force application, the U.S. military will be guided by Rules of Engagement (ROE). According to Joint Publication 1-02, ROE are "directives from national authorities that delineate the circumstances and limitations under which the forces of a country will initiate and/or continue combat engagement with other forces encountered."⁵ *The primary purpose of this paper is to conduct an analysis of the policy, law, and operational factors that comprise ROE as it pertains to negating commercial high-resolution satellite imagery. The secondary purpose of this paper is to develop draft ROE for inclusion in the General Supplemental Measures of the Chairman of the Joint Chiefs of Staff Instruction on Standing Rules of Engagement.*⁶ To facilitate these objectives, an overview of the near term commercial imagery threat is in order.

THE THREAT

Satellite Imagery can be used for a variety of purposes. Its military applications include the technical assessment of enemy capabilities, surveillance of enemy forces, targeting enemy forces, and battle damage assessment.⁷ The ability of a satellite to perform these functions is based on three factors: spatial resolution, spectral coverage, and target area revisit rate.⁸

Spatial resolution is the most important factor in determining the capability of an imagery satellite.⁹ The limited resolutions that are currently available on the open market are suitable for functions such as map production, digital terrain mapping, and fixed target analysis.¹⁰ According to *Janes International Defense Review*, 1-meter resolution is the baseline for military imagery.¹¹ When it becomes available later this year, adversaries will be able to use the high-resolution commercial products to accomplish 60% of the intelligence-related tasks listed in the chart at figure-1.¹²

TARGET	DETECTION ^a	GENERAL ID ^b	PRECISE ID ^c	DESCRIP- TION ^d	TECHNICAL ANALYSIS ^e
Bridges	6	4.5	1.5	1	0.3
Radar	3	1	0.3	0.15	0.015
Supply Dumps	1.5-3.0	0.6	0.3	0.03	0.03
Troop Units (in bivouac or on roads)	6	2	1.2	0.3	0.15
Airfield Facilities	6	4.5	3	0.3	0.15
Rockets and Artillery	1	0.6	0.15	0.05	0.045
Aircraft	4.5	1.5	1	0.15	0.045
Command & Control HQ	3	1.5	1	0.15	0.09
Missiles (SSM/SAM)	3	1.5	0.6	0.3	0.045
Surface Ships	7.5-15	4.5	0.6	0.3	0.045
Nuclear Weapons Components	2.5	1.5	0.3	0.03	0.015
Vehicles	1.5	0.6	0.3	0.06	0.045
Minefields (land)	3-9	6	1	0.03	0.09
Ports and Harbors	30	15	6	3	0.3
Coasts and Landing Beaches	15-30	4.5	3	1.5	0.15
Railroad Yards and Shops	15-30	15	6	1.5	0.4
Roads	6-9	6	1.8	0.6	0.4
Urban Areas	60	30	3	3	0.75
Terrain	-	90	4.5	1.5	0.75
Submarines (surfaced)	7.5-30	4.5-6	1.5	1	0.03

figure-1¹³

The panchromatic image in figure-2 is an example of 1-meter resolution imagery.

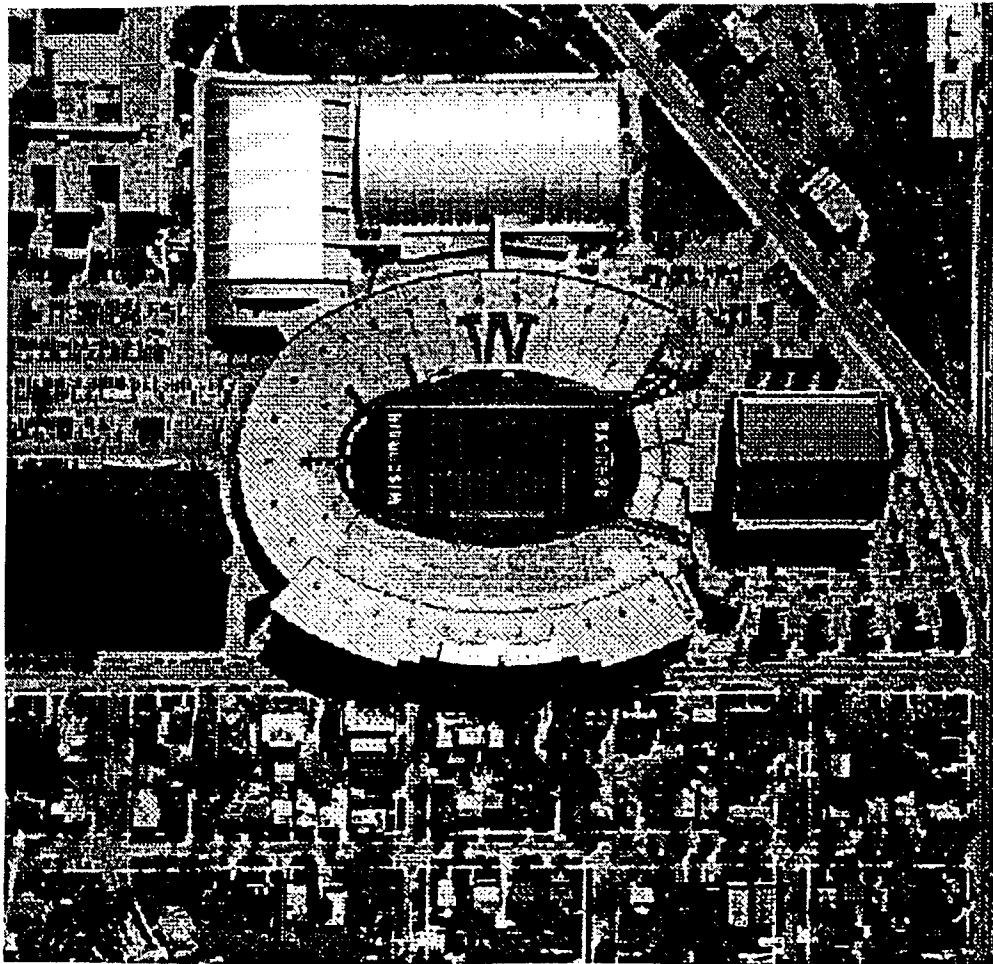


figure-2¹⁴

The second factor that determines the military usefulness of satellite imagery is spectral coverage. The spectral categories that are used in remote sensing include Panchromatic, Infrared, Radar, and Multi/Hyper/Ultra-spectral sensing. Panchromatic sensing provides the highest resolution of the four technologies and is the easiest to interpret, however, it is restricted by weather and darkness. *Infrared imagery* is effective at night, but has reduced resolution and is restricted by weather. *Radar imagery* can penetrate weather and some forms of concealment, but is difficult to interpret. *Multi, Hyper, and Ultra-spectral imagery* each sample wavelengths

across the electromagnetic spectrum to enable tasks such as camouflage penetration, soil analysis and the measurement of moisture content.¹⁵ The limitation of this imagery is that it is difficult to interpret. Although all of these technologies are currently available on the commercial market, only the panchromatic systems are forecast to provide 1-meter resolution.

The third factor that determines the military utility of an imagery satellite is how often it revisits an area of interest. According to Professor Thomas G. Mahnken in *Why Third World Space Systems Matter*, "One-meter imagery [that is] available on a two-day revisit time will nearly eliminate the potential for operational...surprise."¹⁶ As shown in figure-3, the 1-meter systems that are scheduled to be launched during 1999 will come close to meeting this criteria.

Satellite Name	Company	Launch Date	Resolution	Revisit Rate
Ikonos-1	Space-Imaging (US)	Jun-99	1 meter	2-4 days
Orbview-3	Orbimage (US)	1999	1 meter	3 days
EROS B1	West Indian Space (Israel)	1999	1 meter	3 days
QuickBird	EarthWatch (US)	Mid-1999	1 meter	5 days

Figure-3¹⁷

To compliment these revisit rates, impressive down-link and processing times will also be available. For example, the Ikonos-1 system will provide an 11X11km high-resolution image within 18 minutes of collection."¹⁸ This is the reality that operational commanders will soon face, 1-meter imagery available on a timely basis to anyone willing to pay for it. In order to prevent hostile forces from exploiting this commercial capability, commanders must understand the issues that will impact their options and ultimately be reflected in the operational ROE.

THE ELEMENTS OF ROE

In order to be effective, ROE must reflect U.S. Policy, comply with international and domestic law, and take operational factors into consideration.¹⁹

U.S. POLICY

The first consideration in developing ROE is to ensure that it complies with U.S. policy.

Beginning with the Eisenhower administration, American policy has viewed space as a sanctuary from which over-flight and remote sensing could be conducted by all nations without interference.²⁰ This position has recently shifted somewhat in order to accommodate the U.S. intention to establish "information superiority" on the battlefield which includes controlling space related applications such as communication, navigation, surveillance, and meteorology. The *U.S. National Space Policy* was signed by President Clinton in 1996. It states that, "Consistent with treaty obligations, the United States will develop, operate and maintain 'space control' capabilities to ensure freedom of action in space and, if directed, deny such freedom of action to adversaries."²¹ To complement this document, the *1997 Unified Command Plan* was changed to allow US SPACECOM to prepare for the "politically sensitive missions of space control and force application from space."²² Although these documents represent official U.S. Policy, the Clinton administration has been reluctant to allocate the funds which will give the policy teeth. According to Senator Robert Smith, Chairman of the Senate Armed Services Subcommittee for Strategic issues, "The administration gives lip service to the need for space control, but puts little money in the budget to pay for it."²³ This is a two edged sword. Although the administration's actions continue to delay the maturation of military space power, U.S. policy remains committed to preventing the use of space, commercially or otherwise, by hostile forces. This fact will enable the drafting of ROE that will be used to counter the commercial imagery threat.

THE LAW

The second consideration in developing ROE is to ensure that it complies with the international and domestic law that affects military operations in space.

INTERNATIONAL LAW

An excellent starting point for any discussion about armed conflict and international law is the U.N. Charter, which applies to a member nation's behavior on earth as well as in space. There are three primary references in the charter that govern the use of armed force. Chapter I, article 2(4) makes the general statement that members of the UN shall refrain from the threat or use of force against any state.²⁴ In chapter VII, article 42, the UN Security Council is given the power to authorize the use of force in order to maintain or restore international peace and security.²⁵ Finally, the charter affirms the right of nations to act in individual or collective self-defense under Chapter VII, article 51.²⁶ There are nine agreements that act as the current body of international "space law".²⁷ The nine documents include:

- The 1963 Limited Test Ban Treaty
- The 1967 Outer Space Treaty
- The 1968 Agreement on the Rescue of Astronauts and Return of Space Objects
- The 1972 Convention on International Liability for Damage Caused by Space Objects
- The 1972 ABM Treaty with USSR
- The 1973 International Telecommunication Convention
- The 1975 Convention on Registration of Space Objects
- The 1979 Moon Treaty
- The 1980 Convention on the Prohibition of Military or other Hostile use of Environmental Modification Techniques

These treaties and conventions have very little to say about the legality of preventing a third party commercial venture from selling imagery to a belligerent. What they do say is that international law applies in outer space, that outer space is free for use by all countries and not subject to appropriation, that nuclear weapons may not be deployed or detonated in space, and

that space is only to be used for peaceful purposes.²⁸ Although the term “peaceful purposes” remains an area of international dispute, consensus in the United Nations is that “peaceful” means “non-aggressive” and therefore does not exclude the military use of outer space.²⁹ One other important point that applies to the commercial imagery topic is that, “State Parties shall bear international responsibility for national activities in outer space...whether such activities are carried on by governmental agencies or by non-governmental entities...”³⁰ This explicitly charges governments with the responsibility for the actions of companies under their jurisdiction. As for implied or inferred restrictions in the treaties, it is important to understand that the U.S. adheres to the premise in international law that any act not specifically prohibited is permitted. As a function of this premise, Air Force Space Doctrine provides a tidy summary of what the U.S. recognizes as permissible under international law by stating that,

"International space law implicitly permits...the deployment of military space stations; the testing and deployment in Earth orbit of non-nuclear, non-ABM weapon systems, including anti-satellite weapons and space-to-ground conventional weapons; and the use of space for individual and collective self defense as well as virtually any conceivable activity not specifically prohibited or otherwise constrained.”³¹

Hence, there are few restrictions that international "space law" will place on ROE as it applies to negating commercial imagery satellites.

DOMESTIC LAW

The single domestic legal concept that could impact the ROE as it pertains to negating third party commercial imagery assets is referred to as “shutter control”. In an attempt to establish control of the 1-meter imagery market, the Clinton administration published Presidential Decision Directive - 23 during 1994.³² This directive allows U.S. companies to develop “high resolution satellite imagery for commercial use in conjunction with non-US

governments and industrial partners, provided that the U.S. government can block out coverage at any time or place where the dissemination of imagery would harm U.S. national security.”³³ This applies to U.S. owned satellites and to satellites that use U.S. remote sensing technology. There is, however, a legal dispute over the “shutter control” issue. In order for the U.S. federal government to apply “shutter control” and prevent U.S. companies from imaging certain areas, it has to meet a burden of proof described as “Clear and Present Danger.”³⁴ Supreme Court case law defines this as the presence of a threat that could cause “direct, immediate, and irreparable damage to our Nation or its people.”³⁵ According to *Airpower Journal*, some individuals do not believe that the sale of 1-meter imagery will meet this standard and therefore the policy of “shutter control” is sure to be challenged as commercial high-resolution systems become operational.³⁶ In summary, there are currently no domestic laws that would restrict U.S. commanders from drafting ROE that enable the negation of commercial imagery satellites.

THE LAW OF NEUTRALITY

It is clear from the review of existing international and domestic law that there are few legal restrictions on the ability of U.S. forces to negate the commercial space assets under the jurisdiction of a belligerent. But, what happens when a company from a *neutral* nation begins selling high-resolution imagery to a belligerent? Although this area is not currently addressed by “space law”, the void should not last long. According to Michael N. Schmitt in *The Law of Armed Conflict: Into the Next Millenium*, significant changes such as the proliferation of 1-meter commercial imagery cause “new laws to emerge, or outdated and irrelevant laws to fade away.”³⁷ As commercial 1-meter imagery becomes available during 1999, the “space law” that surrounds

the issue of using force to negate commercial imagery satellites should mature. One direction that the law could take is to follow the framework provided by the "Law of Neutrality."

The Commander's Handbook on the Law of Naval Operations defines a neutral nation as a nation that has proclaimed its neutrality or has otherwise assumed neutral status with respect to an ongoing conflict.³⁸ Its principle duties in this case are abstention and impartiality.³⁹ Nations have historically exercised neutrality under customary international law. However, the U.N. charter has changed this somewhat as member nations are now obliged to assist the U.N. when called upon by the Security Council to do so.⁴⁰ Although this compels member nations to act, there are still some situations in which neutrality may be declared.⁴¹ For example, if the Security Council determines not to institute an enforcement action, "each United Nations member remains free to assert neutral status."⁴² Other examples of neutrality include the case of non-member states which remain free at all times to choose their own status as well as states that have declared permanent neutrality such as Switzerland. The Law of Neutrality contains a number of long accepted principles that parallel space operations and could be used as legal justification for taking military action against neutrals that are selling imagery to a belligerent. These principles include:

1. Neutral Commerce. According to the Commander's Handbook, neutral commerce comprises all commerce between a neutral nation and a belligerent that does not involve the carriage of contraband or otherwise contribute to the belligerent's war-fighting or war-sustaining capability.⁴³ It is clear that high-resolution imagery of an adversary's force dispositions is a product that can "contribute to a belligerents war fighting capability" and would therefore not be protected as neutral commerce.

2. Merchant Ships Acquiring the Character of the Enemy. According to the Commander's Handbook, neutral merchant vessels acquire enemy character and may be treated as an enemy merchant vessel "when operating directly under enemy control, orders, charter, employment, or direction." If it could be determined that a neutral satellite is operating under the employment of a belligerent, direct action against the neutral system could be justified. Although it is reasonable to assume that the identity of a commercial imagery satellite will be known, determining who is employing these services could present a challenge. One solution may include working with the imagery company and host nation to allow an impartial observer to monitor the operations of its headquarters and downlink facilities. This would remove any question about whether it is providing imagery to a belligerent. Another solution to the problem of determining who is employing the satellite would be to conduct "Information Operations" and "break-in" to obtain a client list.
3. Belligerent Control of Neutral communications at sea. The commander's handbook states that, "Any transmission to an opposing belligerent of information concerning military operations or military forces is inconsistent with the neutral duties of abstention and impartiality and renders the neutral vessel...liable to capture or destruction."⁴⁴ Once again, this concept could certainly apply to the transmission of high-resolution imagery to a belligerent.

The parallels are clear. Each of these "high seas" examples of violating the "Law of Neutrality" could apply in principle to the sale of high-resolution satellite imagery by a neutral nation.

OPERATIONAL FACTORS

The third element of ROE is operational factors. This element requires an evaluation of friendly capabilities to deny enemy access to space information as well as an assessment of the potential ramifications that could result from direct military action.

DIPLOMATIC SOLUTIONS

It would be operationally unsound for the NCA to publish ROE that authorized the use of force against a neutral without first exhausting diplomatic options.⁴⁵ Diplomatic "space control" is accomplished by persuading states, and by extension the companies under their control, to refrain from providing commercial space support to an adversary. This occurred during Operation DESERT SHIELD when France's SPOT corporation agreed to stop selling commercial imagery to Iraq.⁴⁶ Another example of diplomatic "space control" resides in a statement made by one of the partners involved in the EROS-B1 project. The statement simply said, "you may assume our program will be very sensitive to U.S. concerns."⁴⁷ If the good intentions of the Israeli EROS-B1 owners are combined with the shutter controlled U.S. 1-meter systems, it appears as though the U.S. government will maintain effective diplomatic and legal control of the high-resolution imaging market for the near future.⁴⁸ However, other nations are sure to enter an overhead imagery market that is forecast to reach \$2.65 billion in 2000.⁴⁹ The SPOT corporation of France, which currently owns 60% of the market share in commercial imagery, is currently planning to launch a 1-meter platform by 2002.⁵⁰ As the number of commercial systems increase, there may come a time when diplomacy and legal restrictions fail to achieve "space control", and the U.S. military is called upon to deny enemy access to high-resolution imagery sources.

OPERATIONAL CAPABILITIES

In order to design an operationally sound plan, commanders must understand the adversaries capability to exploit commercial space technology, their means of access, and the control nodes that impact this potential.⁵¹ Once this information is known, the commander may choose from a graduated series of lethal and non-lethal responses to counter the threat. These measures are outlined in U.S. Space Doctrine and include deception, disruption, denial, degradation, and destruction.⁵² They can be implemented through attacks on the space, terrestrial, or link elements of a space system.⁵³

"Deception" consists of "measures designed to mislead the adversary by manipulation, distortion, or falsification of evidence...and can be accomplished in a variety of ways."⁵⁴ Displaying an apparent vulnerability through decoys or misinformation can be used to lure the enemy away from a critical area of operations.⁵⁵ Information in the satellite downlink is also susceptible to deception as "Information Operations" techniques may be conducted to "break-in" and send false data.⁵⁶

"Disruption" is the temporary impairment of the utility of space systems in order to delay critical data from reaching an adversary. Given the time sensitive nature of information required for effective command and control, disruption can cause a major impact. Examples include jamming the downlink or the satellite's sensor package.⁵⁷ Jamming the data during downlink can be accomplished by modified U.S. electronic attack aircraft and helicopters.⁵⁸ Jamming an imagery sensor is referred to as "dazzling". Although there has never been a report of a satellite being 'dazzled' to prevent collection, *Aviation Week and Space Technology* stated that the Mid-Infrared Advanced Chemical Laser (MIRACL) fired at a USAF satellite on 17 Oct 97 and...hit the satellite."⁵⁹ This type of laser energy is ideal for jamming an imagery sensor.⁶⁰

"Denial" is the temporary impairment of a space system, usually without physical damage.⁶¹ One example of this would be to use Special Forces to deny electrical power to the ground structures and computer systems where data is processed and stored.⁶²

"Degradation" is the "permanent impairment...of space systems, usually with physical damage."⁶³ This could be accomplished by a ground-based laser that permanently damages the optics of an imaging sensor without impairing other functions of the satellite bus."⁶⁴ The fact that imaging systems concentrate incident light on a sensitive detector and that they reside in Low Earth Orbit makes them particularly vulnerable to attack.⁶⁵ High-powered microwave weapons are also a consideration as engineers believe they could burn out satellite electronics as distant as 19,600 NM in geosynchronous orbit.⁶⁶

"Destruction" is the "permanent elimination of the utility of space systems...and can include the use of either kinetic-kill or directed energy weapons."⁶⁷ Attacks against a telemetry, tracking and command complex can prevent a satellite from controlling its temperature and orientation, which would likely cause its permanent loss.⁶⁸ Secondary downlink stations can also be attacked. One example of this was the destruction of Iraq's facilities for connectivity with INTELSAT and INTERSPUTNIK during Operation Desert Storm.⁶⁹ The ability to destroy space platforms could also come within reach of the operational commander in the near future. According to the *Federation of American Scientists*, by the year 2000, the U.S. will have a "contingency capability of ten kinetic energy ASATs ready for use if needed."⁷⁰ In addition, following the 1997 test of MIRACL, The *Bulletin of Atomic Scientists* stated that, "If the object had been to destroy the satellite, MIRACL allegedly could have applied extreme heat to cause it to melt."⁷¹ In fact, MIRACL has been referred to as a "designated emergency Anti-Satellite

weapon” by *Arms Control Today*.⁷² According to the US SPACECOM Long Range Plan, the technologies possessed or programmed by the United States include,

“...the Relocatable Laser, Relocatable RF jammer, National Missile Defense Ground Based Interceptor, Ground based lasers, and conventional forces. By 2020, the US SPACECOM plans to include a small RF ASAT kill vehicle, Space based jammers, Space operations vehicle, Space based laser, High Power microwaves, and a Digital RF memory capability to accurately store, replicate, and manipulate coherent signals for retransmission.”⁷³

The options that these assets will give to the commander are depicted in figure-4 and figure-5.

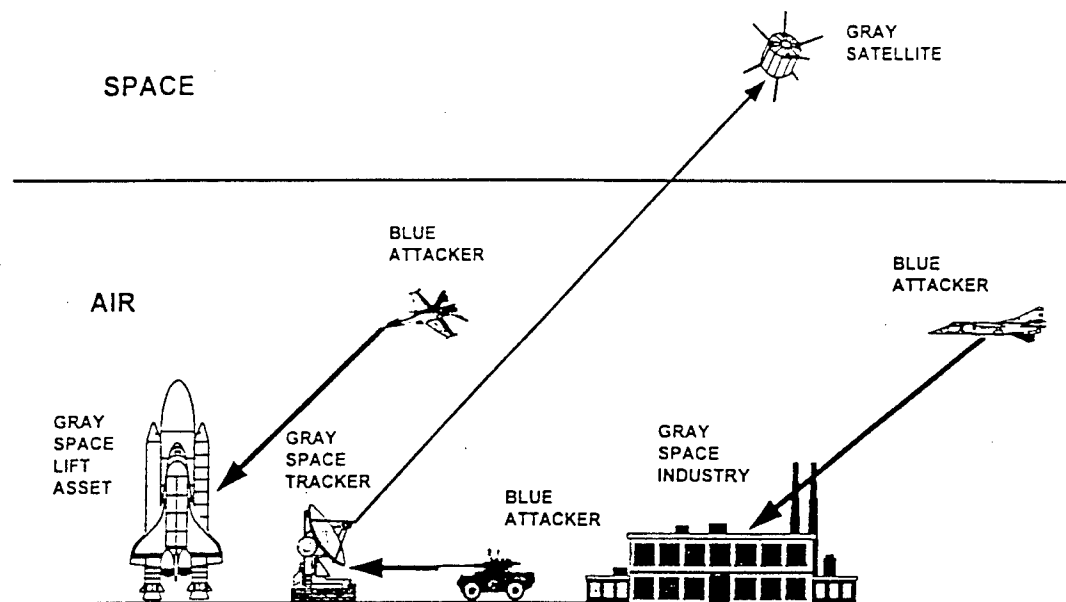


figure-4⁷⁴
Earth-to-Earth Offensive Counter-Space Operations

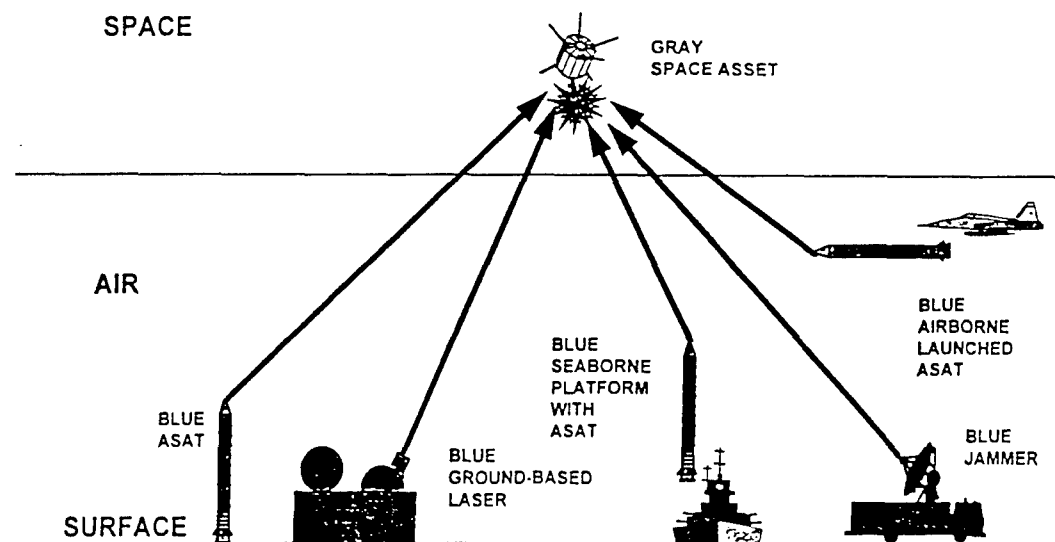


figure-5⁷⁵
Earth-to-Space Offensive Counter-Space Operations

Although U.S. Space Doctrine outlines an excellent range of “offensive counter-space” options, the commander and NCA must exercise caution when considering their use. Any direct action taken against a commercial imagery system could have strategic implications and must be weighed against the practical ability of an enemy to use the product.⁷⁶ In addition to considering the ramifications of provoking a neutral nation, decision-makers must also weigh the prospect of retaliation against America’s space assets, which are currently valued at over \$100 billion.⁷⁷ As the capability to carry out “offensive counter-space” operations is balanced against the backdrop of necessity, risk, and available alternatives, the commander will have to determine whether or not to apply force against the commercial imagery system. These operational factors will certainly impact the ROE concerned with negating commercial space systems.

PROPOSED ROE

The Operations Directorate of the Joint Staff (J-3) is responsible for the development, maintenance, and implementation of the Standing Rules of Engagement.⁷⁸ These ROE serve two distinct purposes which are to "implement the inherent right of self-defense as well as provide guidance for the application of force during mission accomplishment."⁷⁹ Appendix-A to Enclosure-B in the SROE includes the General Supplemental Measures (GSM). These are "essentially a catalogue of draft rules of engagement that decision makers...can turn to in crafting mission accomplishment rules to support a particular operation."⁸⁰ In order to propose General Supplemental Measures that address the negation of commercial imagery space systems, two elements are necessary. These include the level of authorization that is required for approval and a description of what is being requested. For the level of authorization, it is logical that a request to target the commercial space assets of a third party neutral would require NCA approval. The description of the desired action in each GSM should guide planners, but at the same time remain open-ended. The following General Supplemental Measures should be considered for inclusion in the SROE.

A GSM should be available that addresses whether the terrestrial assets, space platform, or earth-space link of a system may be attacked. Although U.S. policy, international law, and operational considerations may allow all three nodes of a commercial space system to be attacked, the NCA or commander may wish to restrict these attacks. This GSM is proposed as follows:

"Measures Requiring NCA Approval"

(XXX) Offensive Counter-Space Operations against the (Terrestrial element/Earth to Space Link/Space platform) of (designated corporation) under the jurisdiction of (nation) is:

- a. Not Authorized
- b. Authorized (under the following circumstances)

Another GSM should address the severity of a planned attack to include the options of denial, disruption, degradation, and destruction. Note that deception operations should not require approval. Although U.S. policy, the law, and operational factors may combine to allow an attack on a neutral nation satellite, the NCA and commander may want to restrict this attack to disruption only. This GSM is proposed as follows:

"Measures Requiring NCA Approval"

(XXX) Offensive Counter-Space Operations using (Denial/Disruption/Degradation/Destruction) against the assets of (designated corporation) under the jurisdiction of (nation) is:

- a. Not Authorized
- b. Authorized (under the following circumstances)

A final GSM should address the type of weapon that may be employed to accomplish the mission. Although U.S. policy, the law, and operational considerations may combine to allow an ASAT attack on the satellite of a neutral nation, the NCA and commander may want to restrict the use of certain types of weapons. This GSM is proposed as follows:

"Measures Requiring NCA Approval"

(XXX) The use of (specific weapons system) for Offensive Counter-Space Operations are:

- a. Not Authorized
- b. Authorized (under the following circumstances)

CONCLUSION

Joint Vision 2010 emphasizes that U.S. forces must obtain "Information Superiority".⁸¹

In order to accomplish this objective, enemy access to commercial high-resolution satellite imagery will certainly have to be addressed. Commanders will have to consider U.S. policy, the law, and operational factors as the basis for ROE that will guide their actions to negate this potentially decisive source of information. Although this analysis of ROE factors has revealed few general impediments to the use of force against commercial imagery systems, each situation must be evaluated separately. These results, as well as the proposed General Supplemental Measures, should be useful to the commander in performing the extremely important task of drafting operational ROE.

NOTES

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- ¹ Sun Tzu, Translated by Samuel B. Griffith, The Art of War (Oxford: Oxford University Press, 1963), 98.
- ² William C. Wellman, "United States National Space Policy and Its Implications on the Operational Commander," (Unpublished Research Paper, U.S. Naval War College, Newport, RI.: 1997), 7.
- ³ Barbara Opall-Rome, "White House Plans Dilution of Export Law." Space News, 7-13 December 1998, 40.; "Earth Observation Satellites: Future", <www.ersc.wisc.edu/ersc/resources/eosf.html>, 21 December 1998.
- ⁴ Michael R. Mantz, The New Sword: A Theory of Space Combat Power (Maxwell Air Force Base: Air University Press, 1995), 7.
- ⁵ Michael N. Schmitt, ed., International Law Studies: Levie on the Law of War (Newport, RI: Naval War College Press, 1998), 246. Reference also made to endnote number 64.
- ⁶ Ibid.
- ⁷ Mantz, The New Sword: A Theory of Space Combat Power, 7.
- ⁸ Thomas E. Nosenzo, "You Can't Spell Space Control 'ASAT' Anymore," (Unpublished Research Paper, U.S. Naval War College, Newport, RI.: 1996), 6.
- ⁹ J. Todd Black, "Commercial Satellites: Future Threats or Allies?," Naval War College Review, Winter 1999, 100.
- ¹⁰ Wellman, Unpublished Research Paper, 7.
- ¹¹ Bill Sweetman, "Spy satellites: The next leap forward," Janes International Defense Review, Jan 1997, 32.
- ¹² Sweetman, Janes International Defense Review, 28; Larry K. Grundhauser, "Sentinals Rising: Commercial High-Resolution Satellite Imagery and Its Implications for US National Security," Airpower Journal, Winter 1998, 63.
- ¹³ Grundhauser, Airpower Journal, 64.
- ¹⁴ One-meter Photo, <http://rs320h.ersc.wisc.edu/ersc/resources/resol/uw01m.gif>, 6 Jan 1999.
- ¹⁵ Nosenzo, Unpublished Research Paper, 6.

-
- ¹⁶ Thomas G. Mahnken, quoted in Nosenzo, Unpublished Research Paper, 8.
- ¹⁷ Ibid., 7.
- ¹⁸ Sweetman, Janes International Defense Review, 30.
- ¹⁹ Ibid., 247.
- ²⁰ Harry Feder, "The Sky's the Limit: Evaluating the International Law of Remote Sensing," International Law and Politics, Winter 1991, 609.
- ²¹ William J. Clinton, Proclamation, U.S. National Space Policy, September 19, 1996, 4.
- ²² William B. Scott, "Plan Strengthens Space Warfighter's Roles," Aviation Week and Space Technology, April 20, 1998, 29.
- ²³ James Hackett, "Space Control Horizon," Washington Times, 11 January 1999, 12.
- ²⁴ U.S. Air Force Department, The Charter of the United Nations, AFP 110-20 (Washington: 1981), 5-3.
- ²⁵ Ibid., 5-7.
- ²⁶ Ibid.
- ²⁷ James Nathan, "The Rise and Decline of Coercive Statecraft," U.S. Naval Institute Proceedings, October 1995, 60.
- ²⁸ U.S. Department of the Air Force, Legal Principles Relevant to Military Activities in Outer Space (Washington, D.C.), 5.
- ²⁹ Morgan, The Journal of Air Law and Commerce, 303.
- ³⁰ Encyclopedia of Public International Law, "Law of the Sea, Air, and Space," (Elsevier Science Publishers, Amsterdam: 1989), 300.
- ³¹ "Space Law, Policy, and Doctrine." Federation of American Scientists.
<<http://www.fas.org/spp/military/docops/usaf/au-18/part02.htm>> (1 January 1999).
- ³² Sweetman, Janes International Defense Review, 30.
- ³³ Ibid.
- ³⁴ Ibid.

³⁵ Ibid.

³⁶ Grundhauser, Airpower Journal, 74.

³⁷ Schmitt, Michael N. Schmitt and Leslie C. Green, ed., International Law Studies: The Law of Armed Conflict: Into the Next Millennium (Newport, RI: Naval War College Press, 1998), 400.

³⁸ Naval War College Oceans, Law, and Policy, Annotated Supplement to the Commander's Handbook on the Law of Naval Operations, (Newport, RI, 1997), 7-2.

³⁹ Annotated Supplement to the Commander's Handbook on the Law of Naval Operations, 7-3.

⁴⁰ Ibid., 7-3.

⁴¹ Ibid., 7-5.

⁴² Ibid., 7-5.

⁴³ Annotated Supplement to the Commander's Handbook on the Law of Naval Operations, 7-16.

⁴⁴ Ibid., 7-30.

⁴⁵ Mantz, The New Sword: A Theory of Space Combat Power, 42.

⁴⁶ Jeffrey L. Caton, "Joint Warfare and Military Dependence on Space," Joint Forces Quarterly, Winter 1995-96, 50.

⁴⁷ Sweetman, Janes International Defense Review, 31.

⁴⁸ Ibid, 31.

⁴⁹ Ibid, 30.

⁵⁰ Larder, Christian. "Spot family's new generation." Interavia, April 1998, 41.

⁵¹ Wellman, Unpublished Research Paper, 10.

⁵² James Nathan, "The Rise and Decline of Coercive Statecraft," U.S. Naval Institute Proceedings, October 1995, 60.

⁵³ Ibid., 60.

⁵⁴ Ibid.

⁵⁵ Nosenzo, Unpublished Research Paper, 12.; Wellman, Unpublished Research Paper, 10.; Black, Naval War College Review, 110.

⁵⁶ Mantz, The New Sword: A Theory of Space Combat Power, 42.

⁵⁷ U.S. Air Force Doctrine Document 2-2, 8.

⁵⁸ Grier, Peter. "The Arena of Space." Air Force Magazine, September 1996, 47.

⁵⁹ Michael A. Dornheim, "Laser Engages Satellite with Questionable Results," Aviation Week and Space Technology, October 27, 1997, 27. ; Earl D. Matthews, "U.S. Space Systems: A Critical Strength and Vulnerability," (Unpublished Research Paper, U.S. Naval War College, Newport, RI.: 1996), 5.

⁶⁰ U.S. Space Command, Long Range Plan, Peterson AFB, CO., 1998, 46.

⁶¹ U.S. Air Force Doctrine Document 2-2, 9.

⁶² Ibid.

⁶³ Ibid.

⁶⁴ Ibid.

⁶⁵ 100-530 NM from the earth's surface. Allen Thomson, "Satellite vulnerability: a post-Cold War issue?" Space Policy, February 1995, 25.

⁶⁶ Earl D. Matthews, "U.S. Space Systems: A Critical Strength and Vulnerability," (Unpublished Research Paper, U.S. Naval War College, Newport, RI.: 1996), 6.

⁶⁷ U.S. Air Force Doctrine Document 2-2, 9.

⁶⁸ Black, Naval War College Review, 109; Mantz, The New Sword: A Theory of Space Combat Power, 41.

⁶⁹ Comments by General Colin Powell. Morgan, The Journal of Air Law and Commerce, 267.

⁷⁰ "Briefing on KE ASAT." Federation of American Scientists. November 1997.
<http://www.fas.org/spp/military/program/asat/brief9711/slide12.html> (17 December 1998).

⁷¹ Todd Lowery, "Call it a MIRACL," The Bulletin of the Atomic Scientists, Jan/Feb 1998, 5.

⁷² Sami Fournier, "U.S. Test-Fires 'MIRACL' at Satellite Reigniting ASAT Weapons Debate," Arms Control Today, October 1997, <<http://www.armscontrol.org/ACT/oct97/miracloct.htm>> (1 January 1999)

⁷³ U.S. Space Command, Long Range Plan, 44.

⁷⁴ Mantz, The New Sword: A Theory of Space Combat Power, 38.

⁷⁵ Mantz, The New Sword: A Theory of Space Combat Power, 43.

⁷⁶ Black, Naval War College Review, 112.

⁷⁷ 11-54-97 Scott, William B. Scott, "Plan Confronts Space Control Issues," Aviation Week and Space Technology, April 13, 1998, 30.

⁷⁸ Grunawalt, The Air Force Law Review, 248.

⁷⁹ Ibid., 247.

⁸⁰ Schmitt, International Law Studies: Levie on the Law of War, 262.

⁸¹ U.S. Joint Chiefs of Staff. Joint Vision 2010. Washington, D.C., 16.

BIBLIOGRAPHY

- Berg-Johnson, Jon F. "Space Control: The Operational Commander's Future Dilemma." Unpublished Research Paper, U.S. Naval War College, Newport, RI: 1994.
- Black, J. Todd. "Commercial Satellites: Future Threats or Allies?" Naval War College Review, Winter 1999, 99-114.
- "Briefing on KE ASAT." Federation of American Scientists. November 1997.
<http://www.fas.org/spp/military/program/asat/brief9711/slide12.html>
(17 December 1998).
- Caton, Jeffrey L. "Joint Warfare and Military Dependence on Space." Joint Forces Quarterly, Winter 1995-96, 48-53.
- Clinton, William J. Proclamation. U.S. National Space Policy. September 19, 1996.
- Dornheim, Michael A. "Laser Engages Satellite with Questionable Results." Aviation Week and Space Technology, October 27, 1997, 27.
- "Earth Observation Satellites: Future". www.ersc.wisc.edu/ersc/resources/eosf.html, 21 December 1998.
- Encyclopedia of Public International Law, "Law of the Sea, Air, and Space," Elsevier Science Publishers, Amsterdam: 1989.
- Feder, Harry. "The Sky's the Limit: Evaluating the International Law of Remote Sensing." International Law and Politics, winter 1991, 599-669.
- Fournier, Sami. "U.S. Test-Fires 'MIRACL' at Satellite Reigniting ASAT Weapons Debate." Arms Control Today, October 1997.
<http://www.armscontrol.org/ACT/oct97/miracloct.htm> (1 January 1999)
- Grier, Peter. "The Arena of Space." Air Force Magazine, September 1996, 44-47.
- Grunawalt, Richard J. "The JCS Standing Rules of Engagement: A Judge Advocates Primer." The Air Force Law Review, 1997, 245-258.
- Grundhauser, Larry K. "Sentinels Rising: Commercial High-Resolution Satellite Imagery and Its Implications for US National Security." Airpower Journal, winter 1998, 61-80.
- Hackett, James. "Space Control Horizon." Washington Times, 11 January 1999, pp. 12.
- Larder, Christian. "Spot family's new generation." Interavia, April 1998, 41-43.

- Lowery, Todd. "Call it a MIRACL." The Bulletin of the Atomic Scientists, Jan/Feb 1998, 5-6.
- Mantz, Michael R. The New Sword: A Theory of Space Combat Power. Maxwell Air Force Base: Air University Press, 1995.
- Matthews, Earl D. "U.S. Space Systems: A Critical Strength and Vulnerability." Unpublished Research Paper, U.S. Naval War College, Newport, RI: 1996.
- Morgan, Richard A. "Military Use of Commercial Communications Satellites: A New Look at The Outer Space Treaty and Peaceful Purposes." The Journal of Air Law and Commerce, Sep.-Oct. 1994, 237-326.
- Nathan, James. "The Rise and Decline of Coercive Statecraft." U.S. Naval Institute Proceedings, October 1995, 59-65
- Naval War College Oceans, Law, and Policy. Annotated Supplement to the Commander's Handbook on the Law of Naval Operations. Newport, RI, 1997.
- Nosenzo, Thomas E. "You Can't Spell Space Control 'ASAT' Anymore." Unpublished Research Paper, U.S. Naval War College, Newport, RI: 1996.
- One-meter Photo. <http://rs320h.ersc.wisc.edu/ersc/resources/resol/uw01m.gif>, 6 Jan 1999.
- Opall-Rome, Barbara. "White House Plans Dilution of Export Law." Space News, 7-13 December 1998, pp. 40:4.
- Schmitt, Michael N. ed. International Law Studies: Levie on the Law of War. Newport, RI: Naval War College Press, 1998.
- Schmitt, Michael N. and Green, Leslie C. ed., International Law Studies: The Law of Armed Conflict: Into the Next Millennium. Newport, RI: Naval War College Press, 1998.
- Scott, William B. "Plan Confronts Space Control Issues." Aviation Week and Space Technology. April 13, 1998, 30-31.
- Scott, William B. "Plan Strengthens Space Warfighter's Roles." Aviation Week and Space Technology, April 20, 1998, 29-30.
- "Space Law, Policy, and Doctrine." Federation of American Scientists.
<<http://www.fas.org/spp/military/docops/usaf/au-18/part02.htm>> (1 January 1999).
- Sweetman, Bill. "Spy satellites: The next leap forward." Janes International Defense Review, Jan 1997, 26-32.
- Sun Tzu, Trans. by Samuel B. Griffith. The Art of War. Oxford: Oxford University Press, 1963.

Thomson, Allen. "Satellite vulnerability: a post-Cold War issue?" Space Policy, February 1995, 19-30.

U.S. Air Force Department. Legal Principles Relevant to Military Activities in Outer Space. Washington, D.C., 1988.

U.S. Air Force Department. Space Operations Doctrine (Air Force Doctrine Document 2-2) Washington, D.C.: August 23, 1998.

U.S. Air Force Department. The Charter of the United Nations. AFP 110-20. Washington, D.C.: 1981.

U.S. Joint Chiefs of Staff. Joint Vision 2010. Washington, D.C.

U.S. Space Command. Long Range Plan. Peterson AFB, CO: 1998.

Wellman, William C. "United States National Space Policy and Its Implications on the Operational Commander." Unpublished Research Paper, U.S. Naval War College, Newport, RI: 1997.